

Airborne Conflict Safety Forum
Harry Nelson

AP/FD TCAS and TCAP

A reminder and update



Content

1

AP / FD TCAS Refresher

2

TCAP Review

First commercial aircraft mid-air collision

7th April 1922 over Picardie
Height 492 ft !!



Farman F-60 "Goliath"
Out of Le Bourget



DH -18
Out of Croydon

Introduction

- In 1990's, introduction of TCAS (Traffic Alert and Collision Avoidance System) to prevent mid-air collision
- Today, that safety goal has been largely achieved (However, the risks remain)
- Future risk,



- Increases in traffic
- Widespread RVSM airspace
- Flight Tracks with Next Gen and Sesar

One TCAS side effect: undesired RAs during 1000 ft separation level-off maneuvers

TCAS 7.0 and TCAS 7.1 - Mandate

TCAS II change 7.0

Mandatory since 2000
as per ICAO annex 10,
EASA EU OPS 1.668 and
FAA FAR 121.356

•TCAS II change 7.1

ICAO Recommendation
From Jan-2014 on new A/C
Before Dec-2017 for all others A/C

European Mandate

From Mar-2012 on new A/C
Before Dec-2015 for all others A/C

Content

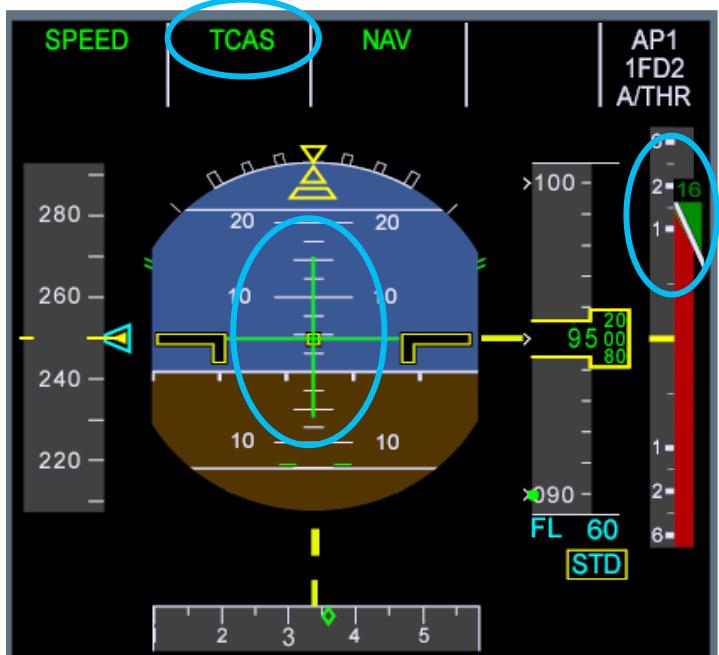
1

AP / FD TCAS Refresher

2

TCAP Review

Auto Pilot / Flight Director TCAS - Refresher



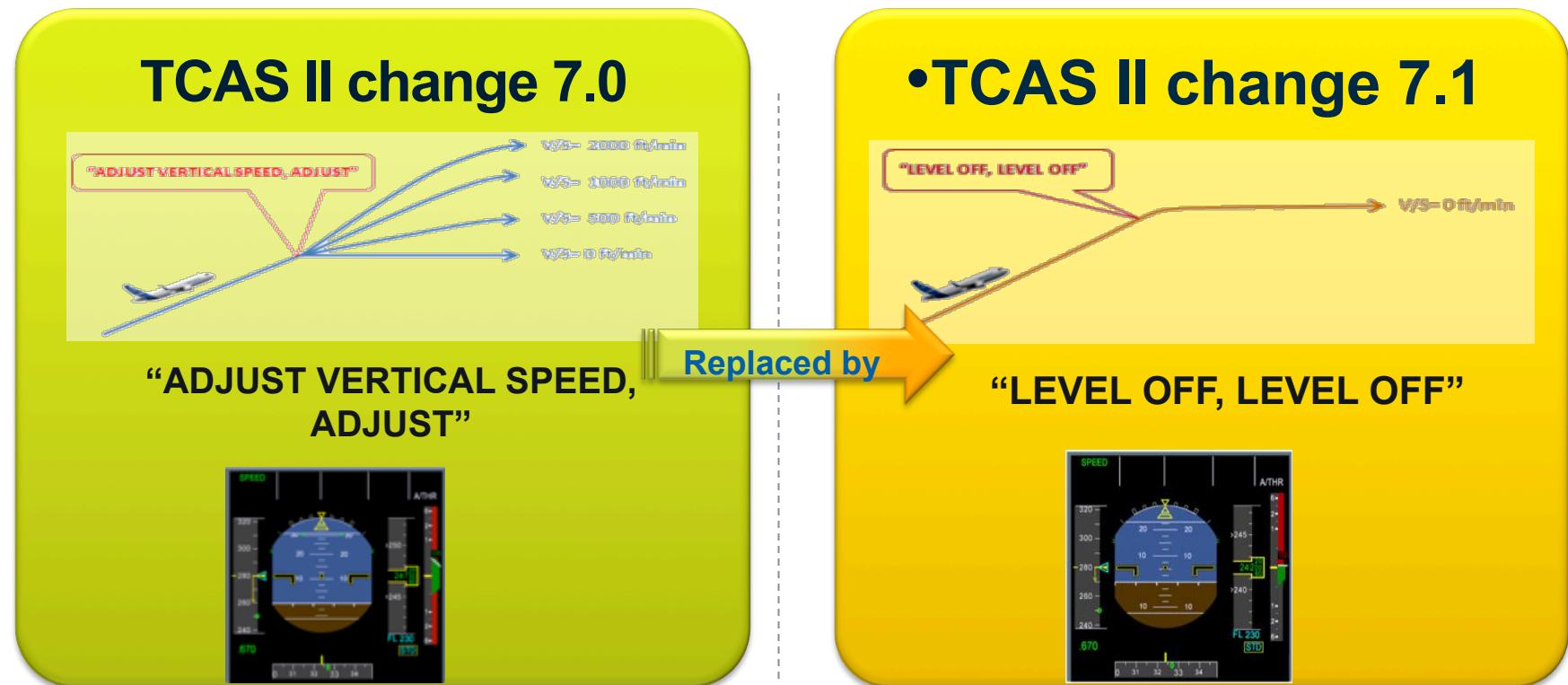
TCAS provides a V/S target to follow on the PFD Vertical Speed Indicator

and

The Auto Flight System (AFS) provides a V/S guidance through AP/FD orders

The AP/FD TCAS combines AFS guidance with TCAS orders to provide an automatic V/S guidance in accordance with TCAS target.

TCAS 7.0 Vs TCAS 7.1 – “LEVEL OFF, LEVEL OFF” RA



Alerts on TCAS system

- Traffic Advisories (TA)

► Audio warning

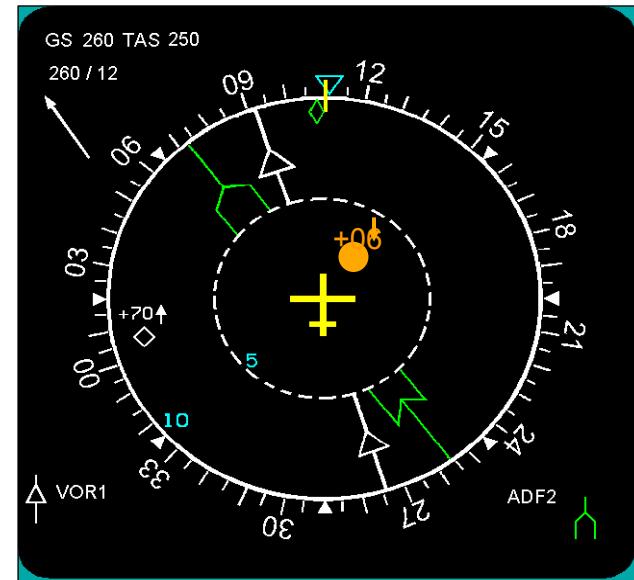


- ▶ Traffic displayed in amber on ND
- ▶ Triggers TCAS “arming” at this stage



- Operational procedure (TA)

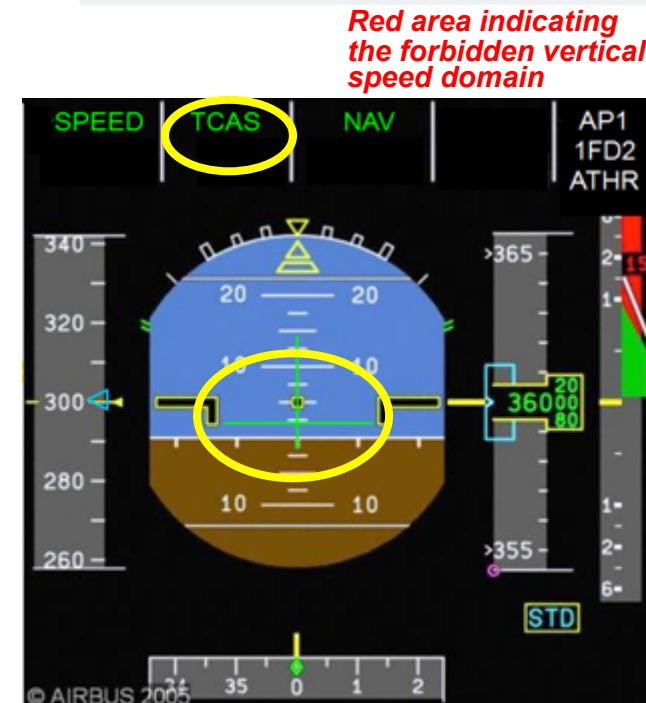
- ▶ No immediate action required (awareness only)



Alerts on TCAS system

- Resolution Advisories (RA)
 - ▶ Different audio warnings, depending on the avoidance maneuver to be performed
 

“Level Off”
 - ▶ Red and green areas on the vertical speed scale
 - ▶ AP/FD Guidance
- Operational procedure (RA)
 - ▶ **Avoidance maneuver required**
 - ▶ Notify ATC



Content

1

AP / FD TCAS Refresher

2

TCAP Review

Airbus solution: TCAP

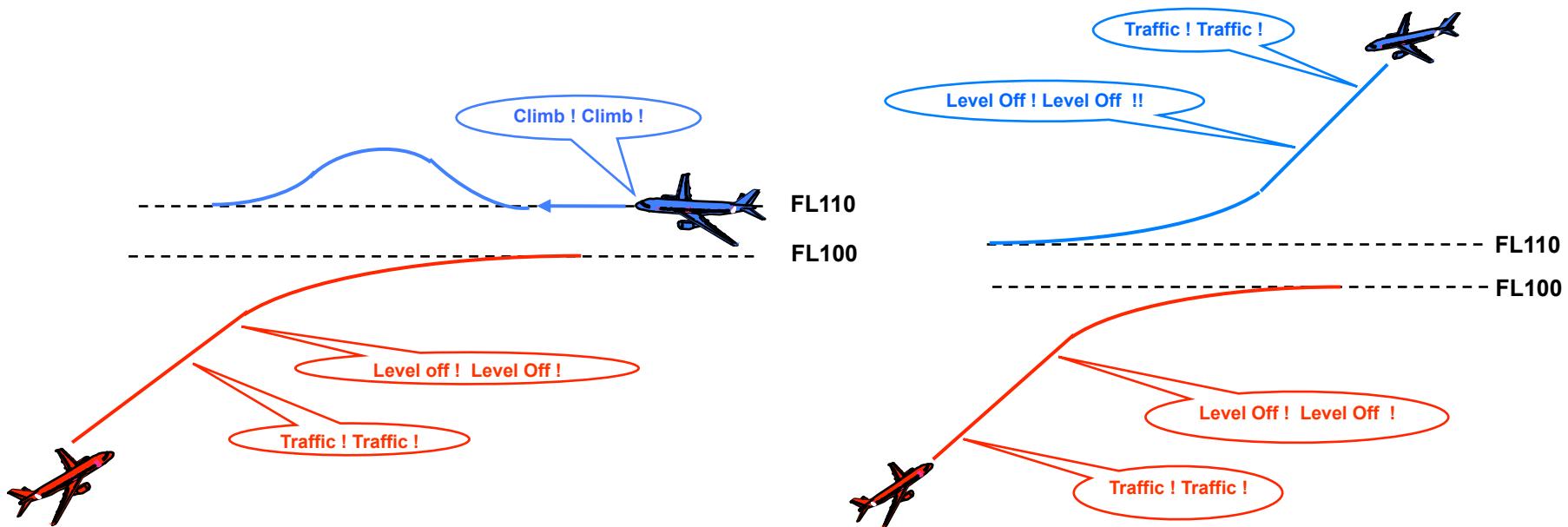
- Objective
 - To reduce the number of operationally undesired TCAS RAs occurring during 1000ft level-off manoeuvres
- Principle
 - Introduction of a new altitude capture law, which decreases convergence rate towards selected altitude when traffic confirmed in vicinity
 - Not a systematic substitute for the conventional altitude capture
 - Activates only when relevant
- Design constraints
 - Retrofittable , Minimum fleet impact, No new threat to HMI levels, Minimum training impact

Airbus solution: TCAP

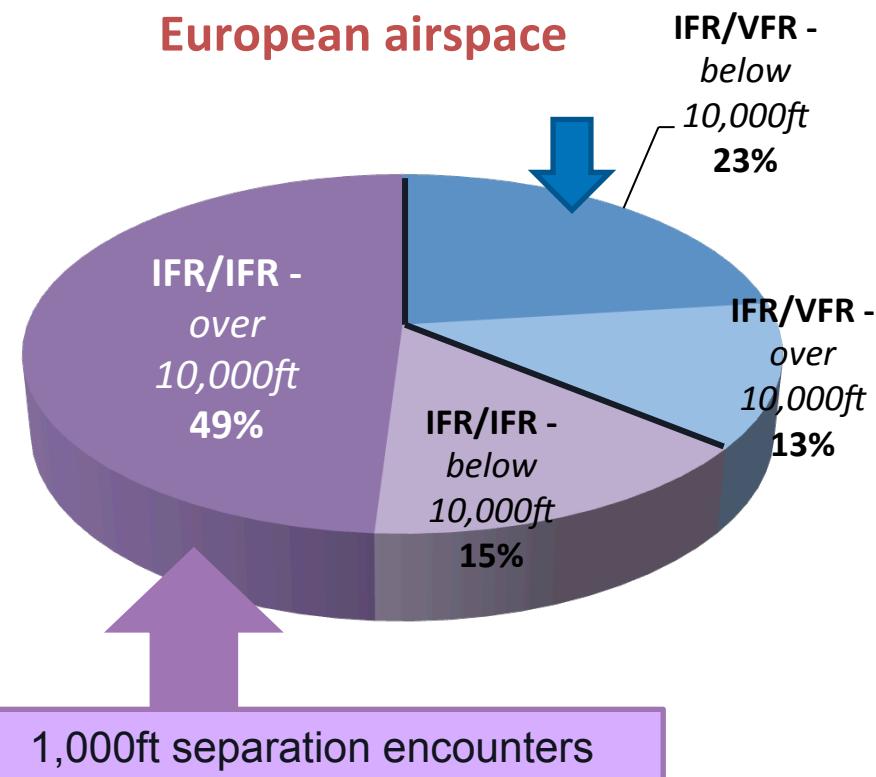
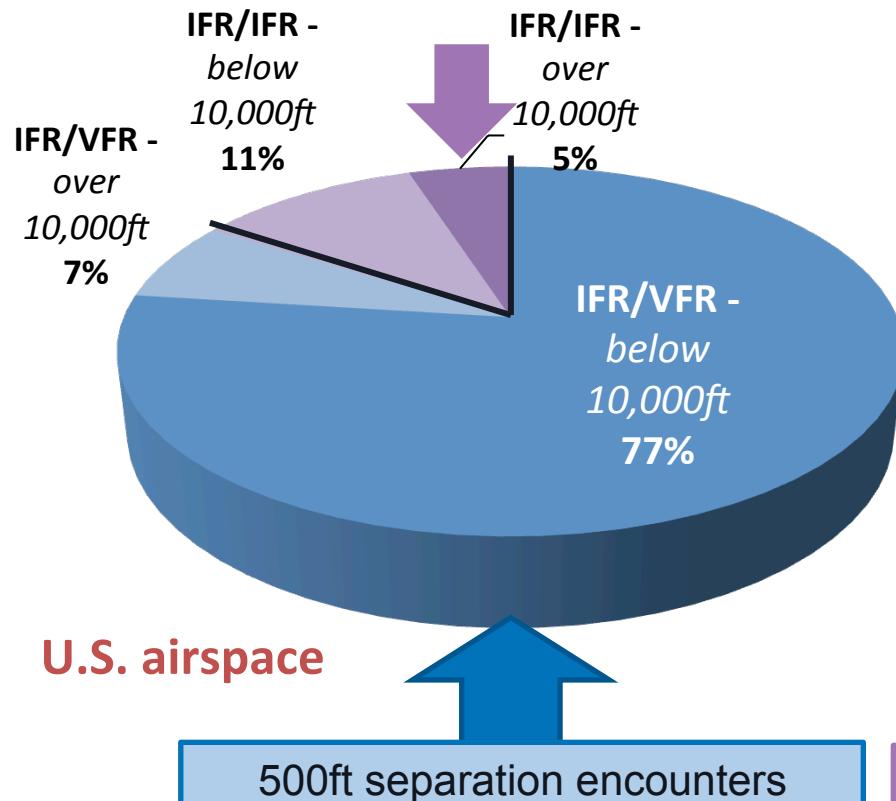
- Activation conditions
 - ▶ TA alert triggered by TCAS (i.e. Traffic converging confirmed)
 - ▶ Plus necessary pre-conditions:
 - ▶ AP and/or FDs engaged
 - ▶ A/C converging towards its selected altitude
 - ▶ Distance to selected altitude factor

Undesired RAs during level-off maneuvers

- More than 50% of RAs generated during level-off manoeuvres



U.S. & European airspace differences (1/2)

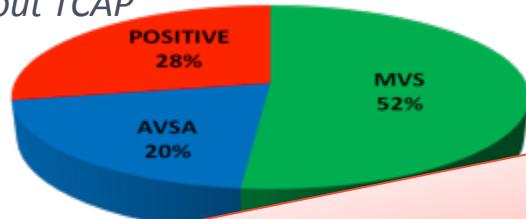


TCAP impact on RAs (4/4)

- Airspace perspective – Type of RAs

- U.S.

- *Without TCAP*



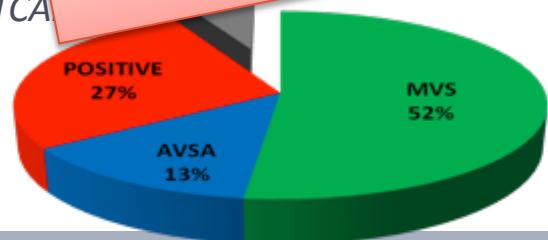
- Europe

- *Without TCAP*

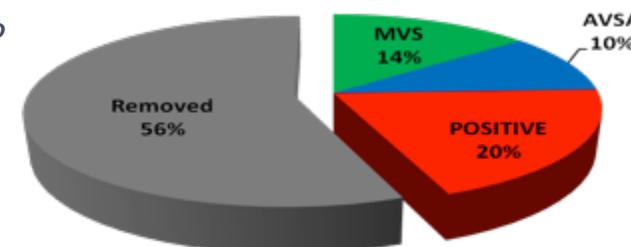


Positive RAs: Climb/Descend
MVS: Monitor Vertical Speed
AVSA: Adjust Vertical Speed

- *With TCA*



- *With TCAP*



Mainly AVSA RAs removed

© Airbus S.A.S. All rights reserved. Confidential and proprietary document. This document and all information contained herein is the sole property of AIRBUS. No intellectual property rights are granted by the delivery of this document or the disclosure of its content. This document shall not be reproduced or disclosed to a third party without the express written consent of AIRBUS S.A.S. This document and its content shall not be used for any purpose other than that for which it is supplied. The statements made herein do not constitute an offer. They are based on the mentioned assumptions and are expressed in good faith. Where the supporting grounds for these statements are not shown, AIRBUS S.A.S. will be pleased to explain the basis thereof.

AIRBUS, its logo, A300, A310, A318, A319, A320, A321, A330, A340, A350, A380, A400M are registered trademarks.